Environmental data acquisition and measuring system based on industry standards

Daniel Lussi[1]; Robert Lukes[2]

INTRODUCTION

Automatic data acquisition is omnipresent in almost every field of modern life: it is intensively used in industrial automation, in production quality monitoring, in environmental observing, or in finance to cite just a few examples. Over time, several standards have been developed for different subsystems of the data acquisition chain. Standards exist for programming, for collecting data, and for supervising systems.

We use automatic data acquisition to monitor hydrological data for long-term studies and for natural disaster prevention. This activity requires a very high level of reliability and availability and thus puts stringent conditions on all components of the acquisition system. Traditionally, the approach chosen to meet these requirements was to build customized solutions based on specific components. The Federal Institute of Metrology (METAS) and the Federal Office for Environment (FOEN) have set up a project to demonstrate the feasibility of a large scale, wide area monitoring network, entirely based on industry standards and off-the-shelf components. Here we report on the standardised hydrological measurement station and on the supervision infrastructure set up to operate the network. Reliability, Availability, Maintainability, and Safety (RAMS) are the main criteria against which the developed solution will be measured.

THE HYDROLOGICAL NETWORK

The backbone of the hydrological survey in Switzerland is a network of roughly 250 data collecting stations distributed all over the country. The number of recorded parameters is not equal at each location, but in general a station logs between 3 and 500 variables. In addition to the data acquisition functions, actuating capabilities (for example for the sampling of water or the regulation of a temperature) are also needed at certain locations. For historical reasons, today the setup is unique on every site with little standardisation among the present stations. As a consequence the controlling and the operation of the network is cost intensive.

THE STANDARD STATION

To facilitate the maintenance of the network it is necessary to homogenise the equipment deployed. As a first step, a standard data collecting station was defined and built. The main blocks of such a station are the data logger, the telecommunication and the power supply.

Instead of an application specific conventional data logger, a general purpose Programmable Logic Controller (PLC) sits at the heart of the station. This part takes care of the cyclic data acquisition, in certain cases a first processing of the raw data (e.g. building of 10 minute average), on-site storage, and preparation for transmission.

There is a huge variety of PLCs available off the shelf. Among them many support the industry standard IEC 61131. This standard harmonises the programming of the PLCs. IEC 61131 contains different graphical and textual PLC programming languages.

By choosing components compliant to this standard, one makes sure that hardware from different manufacturers can be installed. This is particularly important as the lifetime of the network should exceed 15 years and the end-of-life of a specific PLC should not put into question the whole concept of the station.

THE SUPERVISION OF THE NETWORK

As mentioned above, the whole network counts more than 250 stations and covers all of Switzerland. Remote monitoring and control functions from a central point are thus essential. For this purpose a commercially available Supervisory Control and Data Acquisition (SCADA) system has been installed. A SCADA system consists of remote terminal units (RTUs), PLCs, a telemetry system,

a data acquisition server, a human-machine interface (HMI), a Historian database, and a supervisory system. Figure 1 depicts a schematic overview of the system implemented.
For the time being the main path for hydrological data remains FTP with daily data files. However, for the supervisory system, the PLCs are directly connected to the central database over OPC UA (OLE for process control Unified Architecture), an industrial machine-to-machine (M2M) communication protocol. OPC UA allows direct object linking between the PLCs and the central database making scheduled file synchronisation or push and pull commands redundant. Yet again, as this is an open, industrial standard, hardware from different manufacturers (as long as they support the selected standard) can be used.

In addition to the supervisory system an alarming system has been set up. Its purpose is to post messages through various channels (SMS, Email, Fax etc). OPC UA object linking has been used to synchronise the data.

FIELD TEST

To test the developed concepts, 15 standard stations have been built and installed on existing sites. The small network has been run for a period of 3 months allowing the detection of potential weaknesses. At the time of the conference the field test will be completed and we will report on the insights gained with this network, entirely based on industrial standards.

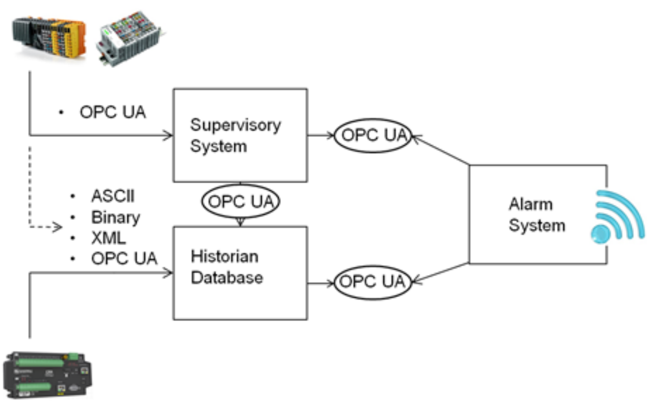

Figure 1. schematic of a SCADA system

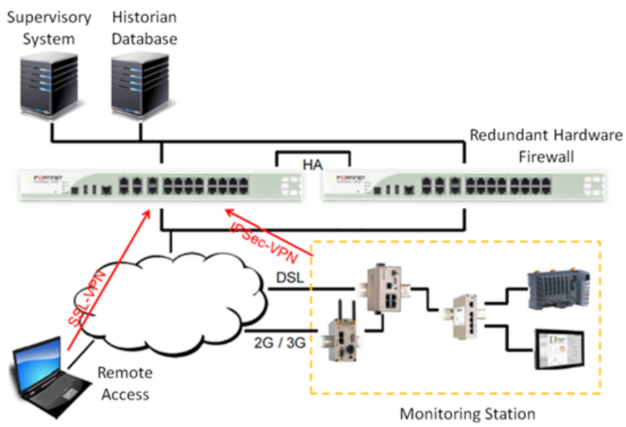

Figure 2. VPN and Security

KEYWORDS

SCADA; OPC UA; Data Acquisition; Industrial Standard; Supervisory System

1 Eidgenössisches Institut für Metrologie METAS, Bern, SWITZERLAND, daniel.lussi@metas.ch
2 BAFU, SWITZERLAND